

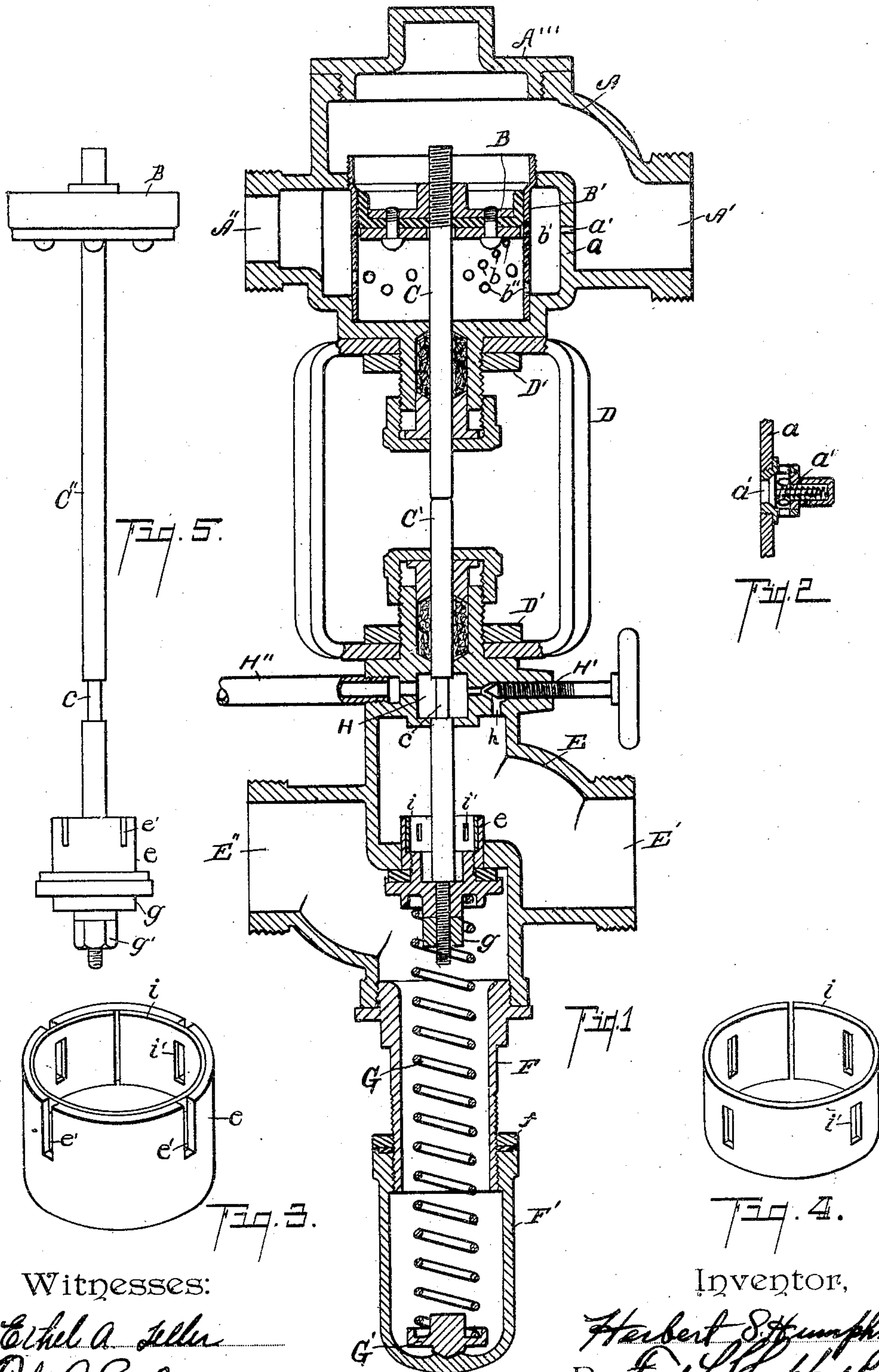
No. 791,028.

PATENTED MAY 30, 1905.

H. S. HUMPHREY.
AUTOMATIC WATER AND GAS VALVE.

APPLICATION FILED APR. 25, 1904.

2 SHEETS—SHEET 1.



Witnesses:

Ethel A. Teller
Otto A. Earl

Inventor,

Herbert S. Humphrey
By *Fred L. Chappell*
Att'y.

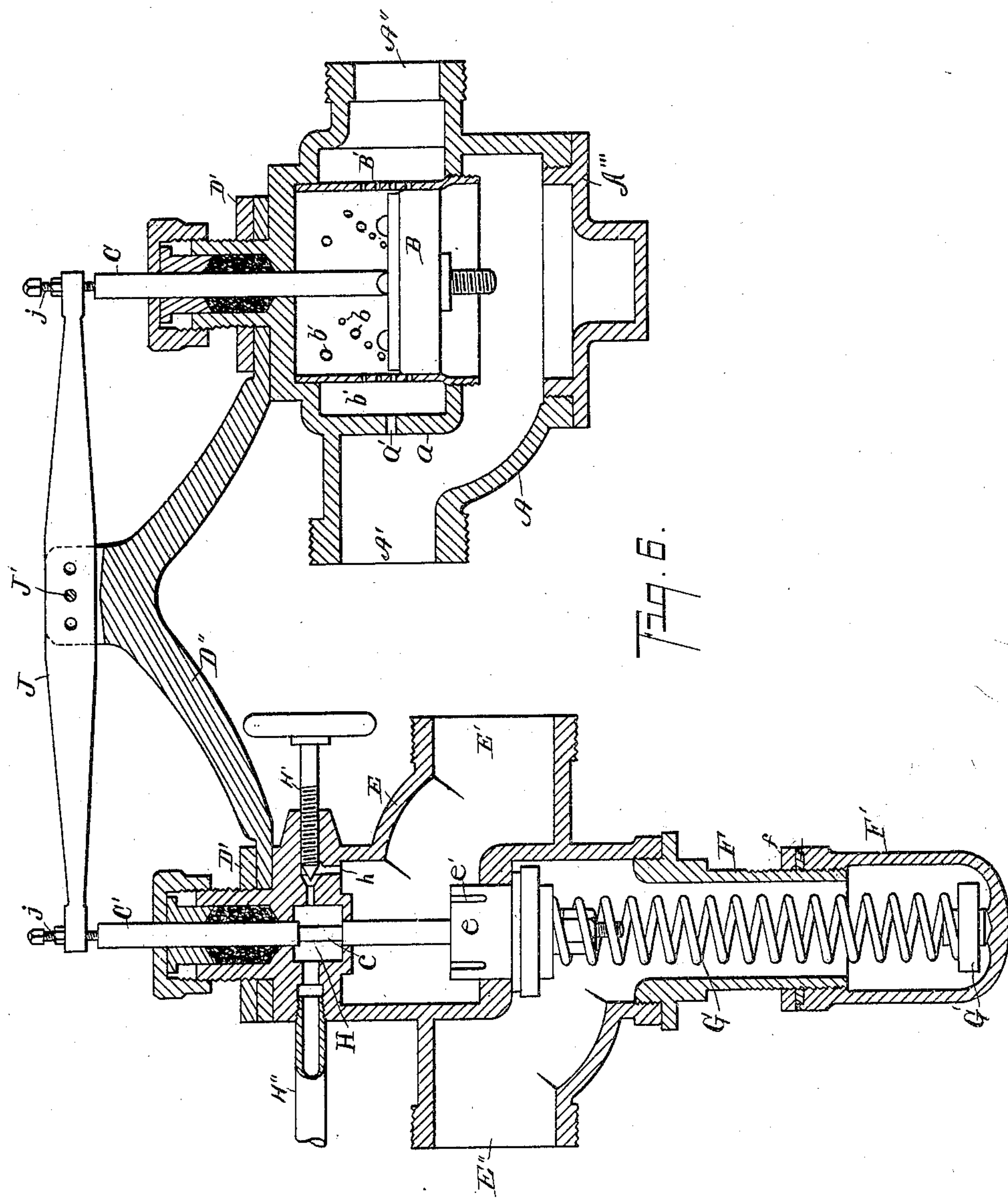
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UNITED STATES PATENT OFFICE.

HERBERT S. HUMPHREY, OF KALAMAZOO, MICHIGAN, ASSIGNOR TO
HUMPHREY COMPANY, OF KALAMAZOO, MICHIGAN.

AUTOMATIC WATER AND GAS VALVE.

SPECIFICATION forming part of Letters Patent No. 791,028, dated May 30, 1905.

Application filed April 25, 1904. Serial No. 204,776.

To all whom it may concern:

Be it known that I, HERBERT S. HUMPHREY, a citizen of the United States, residing at the city of Kalamazoo, county of Kalamazoo, State of Michigan, have invented certain new and useful Improvements in Valves, of which the following is a specification.

This invention relates to improvements in valves. It relates particularly to improvements in automatic water and gas valves for water-heaters, although it is adapted for use in other relations.

The objects of this invention are, first, to provide an improved automatic water and gas valve for water-heaters, by which the pilot-light is automatically actuated or flashed at the proper time for igniting the burners, and also one in which the quantity of gas delivered to the burners is controlled by the quantity of water delivered; second, to provide an improved automatic water and gas valve for water-heaters, in which the quantity of gas delivered to the burners is controlled by the quantity of water delivered to the heater; third, to provide an improved automatic water and gas valve in which the quantity of gas delivered is controlled by the quantity of water delivered, which is readily adjusted to secure that result; fourth, to provide an improved automatic valve for water-heaters, adapted to actuate the pilot-light valve; fifth, to provide an improved automatic water and gas valve which is simple in construction and readily assembled or disassembled and in which the parts are easily accessible for purposes of adjustment or repair.

Further objects and objects relating to structural details will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification.

The invention is clearly defined and pointed out in the claims.

A structure embodying the features of my invention is clearly illustrated in the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a detail vertical sectional view of my improved automatic water and gas valve, showing the relation of the parts. Fig. 2 is a detail sectional view of a modification, showing a check-valve for the port *a'* or by-pass of the water-valve. Fig. 3 is an enlarged detail perspective view of the gas-valve *e*, showing the arrangement of the parts for the adjustment of the valve-ports. Fig. 4 is a perspective view of the adjustable ring *i* of the valve *e*. Fig. 5 is a side-elevation view of the piston-valve B and the gas-valve *e* connected by a stem C'' common to both. Fig. 6 is a detail vertical sectional view of a modified form of my improved valve, the water and gas valves being arranged side by side, with the valve-stems connected by a pivoted lever J.

In the drawings the sectional views are taken looking in the direction of the little arrows at the ends of the section-lines, and similar letters of reference refer to similar parts throughout the several views.

Referring to the drawings, the casing A of the water-valve is provided with inlet and outlet passages A' A'', respectively. Within the valve-casing A is a vertically-arranged cylinder B' for the piston-valve B. The upper end of the cylinder B' opens into the inlet-passage A'. The cylinder B' is provided with a plurality of perforations *b*, which open into the annular passage *b'* about the same. The annular passage *b'* is connected to the outlet-passage A''. The lower perforations *b* are somewhat enlarged, so that when the valve B' is in its inner position the water passes freely. This also prevents clogging of the perforations or ports, as ordinary sediment will pass freely therethrough. Thus arranged, when the piston B is forced downwardly the water passes through the perforations *b* into the annular passage *b'* and thence through the outlet-passage A'' to the heater.

The annular passage *b'* is connected to the inlet-passage A' by a small port *a'* through the wall *a*. This port forms a by-pass through which the water-pressure on each side of the piston is equalized when the flow of the water

through the valve is stopped by the closing of the outlet water-valves. The ports b'' through the inner end of the cylinder B' permit the water to escape from the cylinder to prevent back-pressure on the valve and also prevent vacuums, so that the valve moves freely. The piston is provided with a downwardly-projecting stem C , which is arranged through suitable packing in the casing A .

The casing A is provided with a screw-threaded cap A''' , which is of sufficient size to permit the removal of the piston-valve B and also of the main casing, which is screw-threaded into its seat in the casing A . The casing A is mounted upon a yoke-like bracket D , being retained thereon by a suitable nut D' . (See Fig. 1.) A gas-valve casing E is secured to the bracket D by a lock-nut D' .

The gas-valve casing E is preferably arranged directly under the casing A . The casing E is provided with inlet and outlet passages E' E'' , respectively. The delivery from the inlet to the outlet passage is controlled by the valve e . The valve e is provided with vertically-arranged slot-like ports e' . Arranged within the valve e is an adjustable band i , having vertical slots i' therein, adapted to be brought into registry with the ports e' . This ring or band can be adjusted in the valve, thereby regulating the size of its ports. The band i is preferably formed of an open ring of sheet metal. The ring i is inserted under tension, so that it is retained in position by the spring of the metal, which makes the same very easy to adjust and to assemble.

The valve e is secured to the lower end of the stem C' by a suitable nut, as g . The stem C' projects upwardly through the casing E and engages the lower end of the stem C of the water-valve. The valve e is retained normally in its seat by the coiled spring G , which engages the bottom thereof. The spring G rests on the bearing-block G' . The block G' is arranged in the lower end of the cap F , which is provided with an adjustable tip F' . By this means the tension of the spring can be accurately adjusted. A lock-nut f is provided for the tip F' .

A pilot-light passage H is formed in the upper portion of the valve-chamber E . This passage is connected to the inlet-passage E' of the casing by a by-pass h . This by-pass is controlled by the needle-valve H' . The pilot-light passage H is connected to the pilot of the burners by a suitable delivery-pipe H'' . The stem C' of the gas-valve e is arranged through the passage H and is provided with an annular groove c , which serves as a valve for the passage H . When the gas-valve e is in its normal position, the groove c is embraced by the passage. The groove c is arranged so that the gas is admitted to the pilot before the valve e is opened, thus securing a positive ignition of the burners and prevent-

ing the escape of any considerable quantity of gas, and consequent explosions in the heater.

The by-pass h is adjusted to admit sufficient gas to keep the pilot burning, and when the pilot-valve is opened the pilot is flashed to ignite the burners.

With the parts arranged as described when the water is admitted to the valve B it is forced downwardly by the water-pressure, and the stem C , engaging the stem C' , opens the pilot-valve and the gas-valve. On account of the graduation of the perforations b in the cylinder B' it is evident that the farther the piston B is forced downwardly the greater the proportionate amount of water that will pass the valve. It is also evident that the farther the valve e is opened the greater the amount of gas admitted thereby. I am thus enabled to secure a proper proportion of gas to the amount of water which is passing through the heater. As the delivery-opening of the valve e can be readily adjusted, the proportion of the gas and water can be very accurately determined.

The cap at the lower end of the casing E is screw-threaded to the casing and is of such diameter as to permit the removal of the valve e through the opening. With the parts thus arranged either of the valves can be removed for repair or adjustment without disturbing the other, and with the parts thus connected the entire structure can be readily assembled or disassembled.

In the modified structure shown in Fig. 5 a common stem C'' is provided for the valves B and e . This secures the same operative results as the structure described. It, however, lacks the convenience in assembling and disassembling, it being necessary when the common valve-stem C'' is used to detach one of the valves from the stem before disassembling the structure.

In the modified structure shown in Fig. 6 the water and gas valves are mounted on a bracket D'' and are arranged side by side instead of vertically in relation to each other, the water-valve being inverted. The valve-stems C C' are in this arrangement connected by a pivoted lever J , which is mounted on the pivot J' . This arrangement is of advantage for use in some relations and has the further advantage of making it possible to regulate the throw of the valves by regulating the respective lengths of the arms of the lever. Set-screws j , adapted to engage the ends of the levers C C' , are carried by the lever J . These set-screws are of advantage in that they may be adjusted to secure the perfect connection of the parts, so that there is no slack or play. They are also of advantage in that they save accurate fitting or do away with the necessity for accurate measurements.

My improved combination gas and water valve is, as before remarked, very readily as-

sembled. It is also of advantage in that it may be completely disassembled for the purpose of adjustment or repair. The parts are simple and economical to produce, and it is, as stated, capable of complete adjustment, so that the quantity of gas and water is accurately determined.

I have illustrated and described my improved automatic gas and water valve in the form preferred by me on account of its structural simplicity and economy and convenience in use. I am aware, however, that it is capable of considerable structural variation without departing from my invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a valve-casing having water inlet and outlet passages; a detachable cap for said valve-casing; a piston-valve; a vertically - arranged removable cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder, opening into said annular passage; a perforation opening into said annular passage at the inner end of said cylinder; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting stem for said valve, adapted to engage the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring, arranged in said cup-tip; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

2. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder, opening into said annular passage; a perforation opening into said annular passage at the lower end of said cylinder; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting stem for said valve, adapted to engage the stem of said

piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

3. The combination of a valve-casing having water inlet and outlet passages; a detachable cap for said valve-casing; a piston-valve; a vertically - arranged removable cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting stem for said valve; adapted to engage the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring arranged in said tip; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

4. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder, opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

5. The combination of a valve-casing having water inlet and outlet passages; a detachable cap for said valve-casing; a piston-valve; a vertically-arranged cylinder therefor; an an-

nular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder, opening into said annular passage; a perforation opening into said annular passage at the inner end of said cylinder; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring, arranged in said cap-tip; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

6. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder, opening into said annular passage; a perforation opening into said annular passage at the inner end of said cylinder; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

7. The combination of a valve-stem having water inlet and outlet passages; a detachable cap for said valve-casing; a piston-valve; a vertically-arranged removable cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve; a cap having an adjustable tip portion detachably

secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring arranged in said tip; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

8. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, all coacting for the purpose specified.

9. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting valve-stem for said valve adapted to engage the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; and a bearing-block for the lower end of said spring, arranged in said cap-tip, all coacting for the purpose specified.

10. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing hav-

ing gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve; and a coiled spring adapted to return said valve to its normal position, all coacting for the purpose specified.

11. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; and an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve, all coacting for the purpose specified.

12. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting valve-stem for said valve adapted to engage the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; and a bearing-block for the lower end of said spring, arranged in said cap-tip, all coacting for the purpose specified.

13. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve; and a coiled spring adapted to return said valve to its normal position, all coacting for the purpose specified.

14. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder therefor; an annular passage about said cylinder connected to said water-outlet passage; a plurality of perforations through said cylinder opening into said annular passage; a downwardly-projecting valve-stem for said piston-valve; a valve-casing having gas inlet and outlet passages; a valve having vertical elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; and an upwardly-projecting stem for said valve adapted to engage the stem of said piston-valve, all coacting for the purpose specified.

15. The combination of a piston-valve; a stem therefor; a gas-valve having elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; a stem for said gas-valve operatively connected to the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring, arranged in said cap-tip; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, for the purpose specified.

16. The combination of a piston-valve; a stem therefor; a gas-valve having elongated ports therein; a stem for said gas-valve operatively connected to the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring, arranged in said cap-tip; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, for the purpose specified.

17. The combination of a piston-valve; a stem therefor; a gas-valve having elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; a stem for said gas-valve operatively connected to the stem of said piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, for the purpose specified.

18. The combination of a piston-valve; a stem therefor; a gas-valve having elongated

ports therein; a stem for said gas-valve operatively connected to the stem of said piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage through which the stem of said valve is arranged; an annular groove on said valve-stem adapted to be embraced by said passage when said valve is in its normal position; and a by-pass for said pilot-light passage, for the purpose specified.

19. The combination of a piston-valve; a stem therefor; a gas-valve having elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; a stem for said gas-valve operatively connected to the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring, arranged in said cap-tip; a pilot-light passage; and a valve for said pilot-light passage controlled by said piston-valve, for the purpose specified.

20. The combination of a piston-valve; a stem therefor; a gas-valve having elongated ports therein; a stem for said gas-valve operatively connected to the stem of said piston-valve; a cap having an adjustable tip portion detachably secured to said casing; a coiled spring adapted to return said valve to its normal position; a bearing-block for the lower end of said spring, arranged in said cap-tip; a pilot-light passage; and a valve for said pilot-light passage controlled by said piston-valve, for the purpose specified.

21. The combination of a piston-valve; a stem therefor; a gas-valve having elongated ports therein; a ring having vertical slots therein adjustably arranged within said valve; a stem for said gas-valve operatively connected to the stem of said piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage; and a valve for said pilot-light passage controlled by said piston-valve, for the purpose specified.

22. The combination of a piston-valve; a stem therefor; a gas-valve having elongated ports therein; a stem for said gas-valve operatively connected to the stem of said piston-valve; a coiled spring adapted to return said valve to its normal position; a pilot-light passage; and a valve for said pilot-light passage controlled by said piston-valve, for the purpose specified.

23. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder; an annular passage about said cylinder connected to said water-outlet passage; perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a gas-

valve; connections for said valves; a pilot-light passage; and a valve therefor controlled by said piston-valve, for the purpose specified.

24. The combination of a valve-casing having water inlet and outlet passages; a piston-valve; a vertically-arranged cylinder; an annular passage about said cylinder connected to said water-outlet passage; perforations through said cylinder opening into said annular passage; a port connecting said annular passage to said water-inlet passage; a gas-valve; and connections for said valves, for the purpose specified.

25. The combination of a water-valve; a by-pass for said water-valve; a valve-stem for said piston-valve; a gas-valve having slot-like ports; means for adjusting the size of said ports; connections for said valves; a pilot-light passage; and a valve therefor controlled by said water-valve, for the purpose specified.

26. The combination of a water-valve; a valve-stem for said water-valve; a gas-valve having slot-like ports; means for adjusting the size of said ports; connections for said valves; a pilot-light passage; and a valve therefor controlled by said water-valve, for the purpose specified.

27. The combination of a valve-casing having ports increasing in area toward its inner end; a piston-valve therefor; a by-pass for said valve-casing; a valve-stem for said piston-valve; a gas-valve having slot-like ports; means for adjusting the size of said ports; connections for said valves; a pilot-valve passage; and a valve therefor controlled by the said piston-valve, for the purpose specified.

28. The combination of a valve-casing having ports increasing in area toward its inner end; a piston-valve therefor; a valve-stem for said piston-valve; a gas-valve having slot-like ports; means for adjusting the size of said ports; connections for said valves; a pilot-valve passage; and a valve therefor controlled by the said piston-valve, for the purpose specified.

29. The combination of a valve-casing having ports increasing in area toward its inner end; a piston-valve therefor; a by-pass for said valve-casing; a valve-stem for said piston-valve; a gas-valve having slot-like ports; connections for said valves; a pilot-valve passage; and a valve therefor controlled by said piston-valve, for the purpose specified.

30. The combination of a valve-casing having ports increasing in area toward its inner end; a piston-valve therefor; a valve-stem for said piston-valve; a gas-valve having slot-like ports; connections for said valves; a pilot-valve passage; and a valve therefor controlled by the said piston-valve, for the purpose specified.

31. The combination of a valve-casing having ports increasing in area toward its inner end; a piston-valve therefor; a by-pass for said valve-casing; a valve-stem for said piston-

valve; a gas-valve having slot-like ports; means for adjusting the size of said ports; connections for said valves, for the purpose specified.

32. The combination of a valve-casing having ports increasing in area toward its inner end; a piston-valve therefor; a valve-stem for said piston-valve; a gas-valve having slot-like ports; means for adjusting the size of said

ports; and connections for said valves, for the purpose specified.

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In witness whereof I have hereunto set my hand and seal in the presence of two witnesses.

HERBERT S. HUMPHREY. [L. s.]

Witnesses:

ADELAIDE T. ADAMS,
OTIS A. EARL.